



## NASA STTR 2016 Phase I Solicitation

### T8 Science Instruments, Observatories and Sensor Systems

Science Instruments, Observatories, and Sensor Systems addresses technologies that are primarily of interest for missions sponsored by NASA's Science Mission Directorate and are primarily relevant to space research in Earth science, heliophysics, planetary science, and astrophysics. This topic consists of three Level 2 technology subareas:

- Remote sensing instruments/sensors.
- Observatories.
- In-situ instruments/sensors.

## Subtopics

### T8.01 Technologies for Planetary Compositional Analysis and Mapping

**Lead Center:** JPL

This subtopic is focused on developing and demonstrating technologies for both orbital and in-situ compositional analysis and mapping that can be proposed to future planetary missions. Technologies that can increase instrument resolution, precision and sensitivity or achieve new and innovative scientific measurements are solicited. For example missions, see (<http://science.hq.nasa.gov/missions>). For details of the specific requirements see the National Research Council's, Vision and Voyages for Planetary Science in the Decade 2013-2022 (<http://solarsystem.nasa.gov/2013decadal/>).

Possible areas of interest include:

- Improved sources such as lasers, LEDs, X-ray tubes, etc. for imaging and spectroscopy instruments (including Laser Induced Breakdown Spectroscopy, Raman Spectroscopy, Deep UV Raman and Fluorescence spectroscopy, Hyperspectral Imaging Spectroscopy, and X-ray Fluorescence Spectroscopy).
- Improved detectors for imaging and spectroscopy instruments (e.g., flight-compatible iCCDS and other time-gated detectors that provide gain, robot arm compatible PMT arrays and other detectors requiring high voltage operation, detectors with improved UV and near-to-mid IR performance, near-to-mid IR detectors with reduced cooling requirements).
- Technologies for 1-D and 2-D raster scanning from a robot arm.
- Novel approaches that could help enable in-situ organic compound analysis from a robot arm (e.g., ultra-miniaturized Matrix Assisted Laser Desorption-Ionization Mass Spectrometry).
- "Smart software" for evaluating imaging spectroscopy data sets in real-time on a planetary surface to guide rover targeting, sample selection (for missions involving sample return), and science optimization of data

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returned to earth.

- Other technologies and approaches (e.g., improved cooling methods) that could lead to lower mass, lower power, and/or improved science return from instruments used to study the elemental, chemical, and mineralogical composition of planetary materials.
- Projects selected under this subtopic should address at least one of the above areas of interest. Multiple-area proposals are encouraged. Proposers should specifically address:
  - The suitability of the technology for flight applications, e.g., mass, power, compatibility with expected shock and vibration loads, radiation environment, interplanetary vacuum, etc.
  - Relevance of the technology to NASA's planetary exploration science goals.

Phase I contracts will be expected to demonstrate feasibility, and Phase II contracts will be expected to fabricate and complete laboratory testing on an actual instrument/test article.

## **T8.02 Photonic Integrated Circuits**

**Lead Center: GSFC**

Integrated photonics generally is the integration of multiple lithographically defined photonic and electronic components and devices (e.g., lasers, detectors, waveguides/passive structures, modulators, electronic control and optical interconnects) on a single platform with nanometer-scale feature sizes. The development of photonic integrated circuits permits size, weight, power and cost reductions for spacecraft microprocessors, communication buses, processor buses, advanced data processing, and integrated optic science instrument optical systems, subsystems and components. This is particularly critical for small spacecraft platforms. On July 27, 2015 - Vice President Joe Biden, at an event in Rochester, NY, announced the New York consortium has been selected to lead the Integrated Photonics Institute for Manufacturing Innovation. For details see (<http://manufacturing.gov/ip-iml.html>). Proposed as part of President Obama's National Network for Manufacturing Innovation (NNMI), the IP-IMI was established to bring government, industry and academia together to advance state-of-the-art photonics technology and better position the United States relative to global competition in this critical field. The use of the IP-IMI for work proposed under this topic is highly encouraged. This topic solicits methods, technology and systems for development and incorporation of active and passive circuit elements for integrated photonic circuits for:

- Integrated photonic sensors (physical, chemical and/or biological) circuits: NASA applications examples include (but are not limited to): Lab-on-a-chip systems for landers, Astronaut health monitoring, Front-end and back-end for remote sensing instruments including trace gas lidars Large telescope spectrometers for exoplanets using photonic lanterns and narrow band filters. On chip generation and detection of light of appropriate wavelength may not be practical, requiring compact hybrid packaging for providing broadband optical input-output and also, as means to provide coupling of light between the sensor-chip waveguides and samples, unique optical components (e.g., Plasmonic waveguides, microfluidic channel) may be beneficial.
- Integrated Photonic Circuits for Analog RF applications: NASA applications include new methods due to Size, Weight and Power improvements, passive and active microwave signal processing, radio astronomy and TeraHertz spectroscopy. As an example, integrated photonic circuits having very low insertion loss (e.g., ~1dB) and high spur free dynamic range for analog and RF signal processing and transmission which incorporate, for example, monolithic high-Q waveguide microresonators or Fabry-Perot filters with multi-GHz RF pass bands. These components should be suitable for designing chip-scale tunable opto-electronic RF oscillator and high precision optical clock modules.
- Integrated photonic circuits for very high speed computing: Advanced computing engines that approach TeraFLOP per second computing power for spacecraft in a fully integrated combined photonic and electronic package.

## **T8.03 Detection technologies for extant or extinct life for use on robotic missions**

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**Lead Center: ARC**

One of the biggest questions that NASA is chartered to address, is "Are we alone?" NASA desires to extend the search for existing or past life on non-terrestrial bodies. Leveraging work done on extreme environment ecologies and related fields, technologies are sought that can detect and/or quantify pre-biotic compounds (amino acids, polymers) or unique molecules (organic biomarkers including certain chiral compounds, polypeptides/proteins, lipids, nucleic acid polymers) that may be evidence of living processes. These sensors or instruments should eventually be compatible with small spacecraft, rovers, or small penetrator platforms.

Efforts within this initial STTR activity are to identify potential detection approaches and system architectures that demonstrate a pathway forward for inclusion on future robotic missions. A number of research institutions have capabilities in the supporting technologies that will be critical to detecting life, including research systems deployed in extreme environments, in addition to a large number of laboratory bench techniques that may be adapted to robotic platforms. The industrial partner will be crucial not only in commercializing the technology, but developing it and maturing it towards application on robotic missions. These robotic missions may employ in-situ measurements, or may also use remote sensing methods.